FOODBORNE PATHOGENIC BACTERIA - THEIR SIGNIFICANCE AND CONTROL

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Introduction

It is an interesting fact that in Malta - a small island where fresh and wholesome food is within daily reach - the occurrence of massive food poisoning outbreaks is still evident. During the six year period '83-'89 a total of 1403 cases of food-borne illness were reported, investigated and confirmed by the Public Health Laboratory. Locally the prevalence of food poisoning is highest with Salmonella (61.2%), then Shigella (29.2%), E. coli (7.8%), Campylobacter (1.8%) and Clostridium (1 case) (see table 1).

The Health Services Information Unit (HSIU) estimates that only 10-15% of the actual number of outbreaks that occur are reported to the Health Authorities in Malta.

The aetiological patterns of food-borne illness are specific to each country, and are dependent on various factors such as food preferences, physician and public awareness and laboratory capabilities.

Table1: Food-Borne diseases

	1983	1984	1985	1986	1987	1988	1989
Salmonella	176	85	61	126	93	189	129
Shigella	333	7	8	16	23	11	11
E. coli	0	0	12	40	33	18	6
Campylobacter	0	0	0	0	10	13	2
Clostridium	0	0	0	0	1	0	0

Methodology

A microbiological survey was conducted on food items popularly listed on local hotel menus. The survey commenced in early July and was completed by the end of September '91. The maximum daily environmental temperatures during this period ranged between 26.3°C and 35.5°C with a mean of 28.8°C. Not more than ten different food items were taken from each of the 71 catering establishments visited. Sampling and laboratory techniques were maintained uniform throughout

the survey. The bacteriological assessments were completed at a local Flight Catering quality control unit.

The major aims of completing this survey were:

1. to involve several local establishments in a comprehensive survey on the microbiology and hygiene in retail catering;

2. to analyse the results and possibly identify shortfalls in the local food preparation system;

3. to make constructive recommendations to, microbiologically, improve meal quality, if required.

All the samples were randomly collected. The products collected depended more on their availability on the various menus rather than on samples being made up to the author's discretion. The weight of the collected samples was in the range of 25g-150g each.

Sampling took place in the morning, when food was being either just prepared or in the final stages of preparation. During collection, the samples were aseptically transferred to individual sterile disposable containers and transported in insulated polystrene boxes chilled by dry ice at temperatures ranging from 0°C to 4°C. On arrival at the laboratory, the samples were weighed on an electronic balance, and microbiologically analysed early the same afternoon.

The Microbiological Examination

Each particular meal ingredient was analysed as a single unit. (1) To at least 25g of sample, were added nine times as much 1% buffered peptone water (Oxoid CM509) and homogenised in a laboratory stomacher (Stomacher lab-Blender 400, Seward Medical, London) to produce a homogenised suspension.

Subcultures were then made onto:

Standard Plate Count Agar (Oxoid CM463) and incubated aerobically at 37°C for 48 hours

Violet Red Bile Agar (Oxoid CM107) and incubated aerobically at 37°C for 24 hours

Baird Parkers Medium (Oxoid CM275) and incubated aerobically at 37°C for 24 hours

Perfringens Agar (Oxoid CM543) incubated anaerobically at 37°C for 24 hours

Brilliant Green Agar (Oxoid CM263) and incubated aerobically at 37°C for 24 hours

Further biochemical investigations were carried out on individual colonies, when the results obtained above were not conclusive.

Results I: the sample ingredients were divided into various categories of foods from which they were taken (See Table 2).

Table 2: Microbiology of the various dish types collected

(a)	(b)	(c)	(d)	(e)	(f)	(g)
Starters	44	21(47.7)	2(4.5)	0	2(4.5)	0
Hot Food	207	68(32.9)	0	0	2(1.0)	0
Vegetables	149	47(32.0)	0	0	19(12.7)	0
Desserts	44	20(45.5)	0	0	2(4.5)	0
Sauces	64	16(25.0)	1(1.5)	0	0	0
Ice-Cream	52	20(38.5)	0	0	14(26.9)	0
Total	560	192	3	0	39	0

(a) - Dish; (b) - No of samples; (c) - T.V.C. > 10^5/g;
(d) - S. aureus >100/g; (e) - C. perfringens >100/g;
(f) - E. coli >10/g; (g) - Salm. present in 25g

Salmonella species and Clostridium perfrigens were not isolated from any of the samples.

Staphylococcus aureus was recovered from 3 samples, two of which were taken from the same establishment on the same day. 3000 organisms per gram of sample were detected in a pate' and 2200 organisms per gram in mayonnaise. Cross contamination could have been the cause but this possibility could not be proved since phage typing techniques were not yet available at the laboratory. The other incidence of the organism was in a sea food hors d'oeuvre containing a staphylococcal count of 4200 organisms per gram of sample.

High levels of E. coli were detected in 4.5% of the samples taken from starter dishes (n=44), 32.9% of hot foods (n=207), 12.7% of vegetables (n=149), 4.5% of desserts (n=44), 25% of sauces (n=64) and 38.5% of the ice-creams (n=52).

A second approach to the results was by considering the classification of the samples according to the main ingredient analysed to allow interpretation of the relation between the bacterial populations and the food substrates.

In this study, if fewer than 20 samples of the same ingredient were collected, or a sample consisted of an integral mixture of ingredients, than these were excluded to:

i) avoid the possibility of having a particular class of samples collected from two or less establishments and therefore creating bias, and

ii) avoid misinterpretations when dealing with the microbial flora of a particular ingredient.

Results II

39.2% of cooked vegetables (n=51) exhibited a bacterial contamination higher than 10 organisms per gram of sample as compared to the 32.0% of raw vegetables. Similar contamination was detected in 43.8% ready to serve cold meats (n=32), 76% of fresh cream samples (n=25), 50.9% of cooked poultry meat (n=55) and 38.5% of the ice-creams (n=52).

E. coli was isolated at levels higher than 10 organisms per gram of sample in 12.7% of raw vegetables (n=149), once from 32 samples of a variety of cold meats (3.1%), twice from 25 samples of fresh cream (8%),

once from 55 samples of beef (1.8%) and from 26.9% of ice-creams (See Table 3).

Table 3: Microbiology of the main ingredients in the food samples studied

Ingredient	No of Samples	T.V.C. $>10^5$/g	S.aureus >100/g	C.perfrigens >100/g	E.coli >10/g	Salm. in 25g
Veg (cooked)	51	20	0	0	0	0
Veg (raw)	149	47	0	0	19	0
Meat variety	32	14	0	0	1	0
Fresh cream	25	19	0	0	2	0
Poultry meat	57	29	0	0	0	0
Pasta	25	4	0	0	0	0
Beef	55	23	0	0	1	0
Ice-cream	52	20	0	0	14	0

Interpretation

The results obtained should be treated with care. Although the samples were randomly collected, variable factors during food preparation may determine the presence or absence of food-borne pathogens.

To be able to identify nationwide hazards in retail catering, a much larger sample size covering a wider range of outlets is required and the investigation extended over a longer time period. This study was conducted during the busiest period when food would be prepared and stored in bulk and also when the highest environmental temperatures are attained in Malta.

Bacteria may not be uniformly distributed in a food substrate and therefore microbiological analysis should only supplement a quality control procedure. Therefore the absence of bacteria from a food sample

only means that no bacteria were cultured from that particular sample when utilising a particular technique, but bacteria could have been present on other parts of the bulk product from which the sample was taken.

Another variable feature involved in food preparation is the actual food handler. In the preparation area, grades vary from that of a head-chef to a kitchen helper. Different grades receive different amounts of knowledge and both their hygienic practices and considerations would be different, thus affecting the final microbiological quality of a meal.

Discussion

In the food industry, the control of food-borne pathogens has to be consistently achieved to ensure that food is safe for consumption. However, conventional approaches rarely constitute a true control system; these approaches are generally haphazard and not directed towards specific food products. If the link between food safety and its microbiological control is not understood, it is easy to regard hygiene as an end in itself rather than a means to an end, with the result of wasting money, effort and achieving unsatisfactory practices.

During the study, hygiene regulations in the food preparation areas were screened and found to be excellent. However, massive outbreaks of food-borne illness especially during the summer season are still evident.

Several raw ingredients such as meat, milk and vegetables are brought to the preparation area by outside suppliers. Although these usually have their own standards, raw ingredients may pose a potential contaminating hazard especially if such items are not properly transported and adequately stored. Faults with such food may not have originated within the actual food preparation area. However the results obtained stress the need to sanitize vegetables prior to use and to store milk products and similar high risk items at chill temperatures for short periods.

Consistently high surface colony counts may be due to several factors from lack of equipment sanitation, to preparing foods hours in advance of consumption. Though the surface bacteria isolated may not be harmful to health, from the results it can be deduced that food was not prepared, stored or adequately treated to control the growth of pathogenic bacteria

and hence a single incidence of a pathogenic organism, may within hours reproduce to form an infective dose.

Education of food handlers seems to be the most effective step in upgrading the local quality standards, but implementing an academic course seems to be a very difficult task. In the past four years, an average of 33 students were allowed to pursue courses related to food preparation at the local catering school and only 3-6% of the courses are hygiene oriented.

The role of food control officials is still locally wide and varied, with the consequence that catering outlets are inspected randomly on a "management by crisis" basis, which only helps to rectify errors in the food preparation system rather than prevent food poisoning outbreaks.

Conclusion

In Malta, mass catering is still a recently emerging technology and food preparation still follows the traditional cook-serve system. However the present trends in the introduction of "meals on wheels" and other institutional catering systems, suggest that long term storage systems such as cook-chill and cook-freeze will be considered in the near future to ensure microbiologically safe food. Installing such systems requires strict hygienic practices and a better approach to food preparation should be followed.

Recommendations

1. The present Food Act of 1972 and the associated regulations should be revised to incorporate more recent food preparation technologies, which pose higher microbiological risks to food, and also to consider recent discoveries such as the ability of Listeria monocytogenes to grow at refrigeration temperatures and its incidence in milk and its products.

2. Catering courses especially in hygiene, should be set in a manner to allow more students to participate in these courses.

3. Increase in the number of personnel in the food control office enhances frequent regular programmed inspections to mass catering establishments.